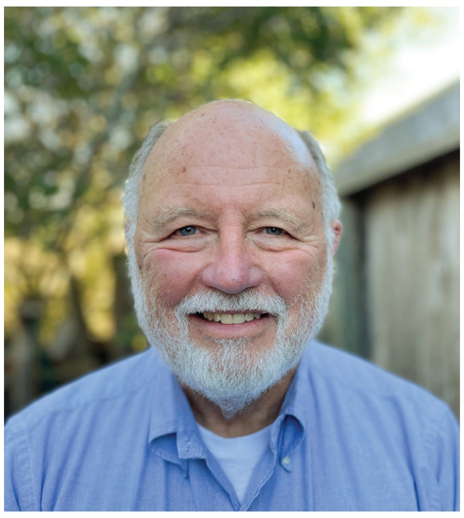
TUESDAY
MAR
28

The Department of Earth and Environmental Sciences presents

ADRIAN SMITH 2023 LECTURE

Characterization Studies of the Waste Rock Dumps at the Bingham Canyon Mine, Utah, USA.



MARK J. LOGSDON

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Mark Logsdon is a geochemist with 50 years of experience in geology, hydrogeology, and environmental chemistry related to mining and mine-waste management. His work experience includes teaching, mining-exploration geochemistry, government service, research, and consulting.

Abstract The Bingham Canyon Mine is surrounded by more than 5 billion tonne of waste rock developed over the open cut mining history from 1903 to present; the surface area of the waste rock is approximately 2,000 hectares. Waste rock dumps have a thickness to in excess of 300 m from crest to sole. From 1930 to 2000, selected portions of the waste rock dumps were actively leached using a ferric-sulfate-based, acidic lixiviant to extract copper, whereas other portions have only received meteoric leaching.

From 2011 to present, Rio Tinto Kennecott has studied the evolution and geochemical controls on water quality associated with the waste rock dumps at the Bingham Canyon Mine. In this program, the waste rock dumps have been characterized in detail from field logging and instrumenting 13 paired borings; at 12 of the 13 locations, the borings penetrated the full depth of the dumps, through the pre-mine soil contact, and into bedrock. Borings were installed to depths approaching 275 m below ground surface using roto-sonic drilling methods to enable (1) core recovery and (2) measurement of near in-situ properties. Field logging of the borings included Unified Soil Classification System descriptions, clast lithology, relative oxidation, paste pH, and geophysical methods (gyroscopic, temperature, neutron, and gamma). Core from the borings was analyzed for geotechnical properties (density, grain size distribution, moisture content, plasticity index and limit, and direct and block shear), quantitative evaluation of minerals by scanning electron microscopy (QEMSCAN), modified acid-base accounting (ABA), modified synthetic precipitation leaching procedure (SPLP), hyperspectral analysis by Corescan, and grab samples of water (if encountered). Instrumentation installed within the borings included lysimeters, thermistor nodes, direct temperature sensing (DTS) fiber optic cables, time domain reflectometry (TDR) shear cables, gas (oxygen, carbon dioxide) measurement tubes, and vibrating wire piezometers (VWPs). Additionally, each drill site had multiple measurements of oxygen consumption in the surface layer of the local waste rock.

Data acquired from the borings were linked with historical information (over a period of greater than 50 years) from extensive drilling, mineralogical and litho-geochemical evaluations, hydraulic and tracer testing, and 20 years of seepage flow and water quality data to develop a conceptual model that describes the hydraulic, geochemical, and physical behavior of the waste rock dumps. Pyrite and other sulfide minerals in the waste rock dumps are oxidized by both diffusive and convective ingress of air, producing acidic, high-total dissolved solids effluents, and jarosite that has formed within the waste rock as a secondary phase that stores additional acidity. The dominant air ingress mechanism is convection, which accounts for greater than 90% of the sulfide oxidation within the waste rock dumps. Based on temperature profiles and water balance for the dumps, moisture loss to geochemical reactions is a significant portion of the water budget.

WHEN

March 28, 2023
2:00 P.M.

Free Admission
Reception in DC 1301

WHERE

University of Waterloo
DC 1302

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